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| EXAMINER | |
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| JONAITIS, JUSTIN M | |
| ART UNIT | PAPER NUMBER |
| 3752 | |

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**Please find below and/or attached an Office communication concerning this application or proceeding.**

The time period for reply, if any, is set in the attached communication.

| Office Action Summary | Application No. | Applicant(s) | |
|---|---|---|---|
| | 10/597,000 | HOU, DEYANG | |
| | Examiner | Art Unit | |
| | JUSTIN JONAITIS | 3752 | |

*-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --*

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

1)☒ Responsive to communication(s) filed on *11 September 2009*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

4)☒ Claim(s) *1-23* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☐ Claim(s) *1-23* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

**Application Papers**

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *04/28/2008* is/are: a)☐ accepted or b)☒ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☒ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

## DETAILED ACTION

1. This office action is responsive to Applicant's amendments filed 09/11/2009.

### *Drawings*

2. The drawings are objected to under 37 CFR 1.83(a). The drawings must show every feature of the invention specified in the claims. Therefore, the circular ring aperture of claim 1, the conical surface being a single conical surface of claim 3, the conical surface with 2 or conical surfaces of claim 4, the sac hole or valve controlled orifice of claim 4, the variable circular aperture of claim 15, diagrams of flow during low to medium pressure and diagrams of flow during high pressure of claim 15, and the system with fluid as the driving means of claim 20, must be shown or the feature(s) canceled from the claim(s). No new matter should be entered.

3. The drawings are objected to under 37 CFR 1.83(b) because they are incomplete. 37 CFR 1.83(b) reads as follows:

> When the invention consists of an improvement on an old machine the drawing must when possible exhibit, in one or more views, the improved portion itself, disconnected from the old structure, and also in another view, so much only of the old structure as will suffice to show the connection of the invention therewith.

Specifically the details of the drawings are too small to accurately see the details of the invention using the reference numbers and letters provided in the specification.

Corrected drawing sheets in compliance with 37 CFR 1.121(d) are required in reply to the Office action to avoid abandonment of the application. Any amended replacement drawing sheet should include all of the figures appearing on the immediate prior version of the sheet, even if only one figure is being amended. The figure or figure number of an amended drawing should not be labeled as "amended." If a drawing figure is to be canceled, the appropriate

figure must be removed from the replacement sheet, and where necessary, the remaining figures must be renumbered and appropriate changes made to the brief description of the several views of the drawings for consistency. Additional replacement sheets may be necessary to show the renumbering of the remaining figures. Each drawing sheet submitted after the filing date of an application must be labeled in the top margin as either "Replacement Sheet" or "New Sheet" pursuant to 37 CFR 1.121(d). If the changes are not accepted by the examiner, the applicant will be notified and informed of any required corrective action in the next Office action. The objection to the drawings will not be held in abeyance.

### *Claim Objections*

4. Claims 11-13, objected to under 37 CFR 1.75(c) as being in improper form because a multiple dependent claim 3-6. See MPEP § 608.01(n). Accordingly, the claims 11-13 have not been further treated on the merits.

5. Claim 19 is objected to under 37 CFR 1.75(c) as being in improper form because a multiple dependent claim s 3-6, 11-13, 17-18. See MPEP § 608.01(n). Accordingly, the claim 19 has not been further treated on the merits.

### *Claim Rejections - 35 USC § 112*

6. The following is a quotation of the first paragraph of 35 U.S.C. 112:

> The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

7. Claims 1-23 are rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the enablement requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to enable one skilled in the art to which it pertains, or with

which it is most nearly connected, to make and/or use the invention. Specifically it's unclear what the difference in flow is when flowing at a low-to medium injection load and a high injection load. Per claim 1, the micro-variable-circular orifice comprises a variable circular ring aperture and at least one micro-channel. Therefore it's unclear how the variable circular aperture of claims 15 and 16 can produce a different flow depending on the injection load. Claims 15 and 16 state at low-to medium pressure fuel is injected through the variable circular aperture (which again according to claim 1 comprises the micro-channels), and at high injection flows through the variable circular aperture and the micro channels. It's unclear as claimed how the flow is any different at various injection loads since in any state the fluid should pass through the variable circular aperture according to the claim. Further in regard to claim 16 it's unclear how different penetrations are determined and how the micro channels are opened or closed as no structure for opening and closing the micro-channels has been disclosed. Further still applicant states the needle head can completely block the variable circular aperture and fuel is injected through the micro channels. However it's unclear how this is possible since according to claim one the circular aperture comprises the micro channels, therefore if the circular aperture is blocked of fluid flow the micro channels should be as well. Because of such, claims 15 and 16 have not been given patentable weight.

8. Claim 1, 2, & 17 are rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the enablement requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to enable one skilled in the art to which it pertains, or with which it is most nearly connected, to make and/or use the invention. Specifically, it's unclear what the device is doing in any of the states of fuel injection. The claim states that the minimum cross-section is at the sealing surface during the early stage (examiner

assumes this means it's sealed), then at the middle stage of fuel injection the minimum cross-section (of the nozzle body) is at the micro-variable-circular-orifice or at the sealing surface. First, it's unclear what applicant is referring to as the minimum cross-section, examiner assumes applicant means the minimum cross section of channel formed within the nozzle body which the head of the needle is formed. Second, the minimum cross section is the point where the micro-variable-circular-orifice is formed in the injector, so it's unclear how its position would change from the first stage of fuel injection to the second stage, further "the minimum cross-section is at the said micro-variable-circular orifice" can be neglected based on the or statement and read, "the minimum cross-section is at the sealing surface during the middle stage of fuel injection," which would mean that the needle has not moved from the first to second stage. Claim 17 then continues to state "the minimum cross-section is at the sealing surface again during the late stage of fuel injection," which again the needle has not moved as it's changed states. Finally the claim states, "whereby it has means of ensuring fine atomization during all fuel injection stages." It's not clear what the means for ensuring fine atomization is referring to and appears that no fuel has been injected on any "stage" since the needle has not moved. Because of such, claim 17 has not been given patentable weight.

9. The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

10. Claims 1-23 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. Specifically it's unclear what applicant means by micro-variable circular orifice and variable circular ring aperture. Examiner cannot determine if the variation of the orifices are based on the location of the needle and how it varies the flow of fluid to the aperture, or if the

apertures themselves are designed to change in size. For examination purposes examiner will assume it's the location of the needle varying the flow, and not the aperture itself being variable.

11. Claim 5 is rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. Specifically it's unclear how a conical surface can be a diverging curved surface and still be a cone. For examination purposes examiner assumes the conical surface is diverging.

12. Claim 8 recites the limitation "tip" in the 4th line of the claim. There is insufficient antecedent basis for this limitation in the claim.

13. Claims 14 and 15 recites the limitation "variable circular aperture" in the 4th line of the claim. There is insufficient antecedent basis for this limitation in the claim.

***Claim Rejections - 35 USC § 102***

14. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

15. Claims 1-5, 8, 14, 18, 21-23 rejected under 35 U.S.C. 102(b) as being anticipated by U.S. Patent #6,467,702 to Lambert et al.

In re claims 1-2, 8, 14, 18, and 21-23, Lambert discloses a mixed-mode fuel injector comprising a nozzle body (nozzle body (10)) comprising passages for fuel (supply passage

(62)), an inner cylindrical space (bore (11)) for receiving a needle valve (valve needle (12)) , and a conical surface (seating surface (11b) or region below of item defined as (11c) in figure 4) close to the tip of the nozzle body for guiding a spray of fuel. The valve needle having a converging-diverging conical head (portion of head by drillings (18) are converging-diverging) for guiding a spray of fuel and which is moveable back and forth and received in the nozzle body, where said needle valve is at a biased closing position (see Figure 4) with it's sealing surface (portion of conical head) pressed against the nozzle body (at seating surface (11b)) to block fuel flow and an opening position (figures 5 and 6) defined by driving means.

Lambert further discloses a micro-variable-circular orifice comprising a circular ring aperture (defined by the region between seating surface (11b) and valve needle that variably opens depending on the positioning of the valve needle) which is between the valve needle and the nozzle body and is the sole orifice for fuel to be injected and a plurality of micro channel (outlet openings (15) and (21)) such that fuel received by the variable circular ring aperture is dischargeable in variable sprays. Where the needle head remains partially received within the tip of the nozzle body as the needle valve is moved back and forth between positions such that when fuel is injected through the micro variable aperture fuel is also injected through the multiple micro-channels, where the upper surface of the needle head (the diverging portion) and conical surface (seating surface (11b)) serve as guides for fuel sprays. Where the micro-channels are formed below the conical surface forming a valve-covered orifice (depending on the location of the needle) by blocking the aperture with the needle head at a predefined needle-lift range. The centerline of the nozzle body and the conical surfaces are the same (0 degrees between).

The fuel injector is driven by an actuator which is a piezo actuator [column 5, lines 27-29]

In re claim 3, Lambert discloses the invention as described above including the conical surface having a single conical surface (seating surface (11b))

In re claims 4 and 5 Lambert discloses the invention as described above including the conical surface having two conical surfaces (seating surface (11b)) and the diverging surface located below item defined as (11c) in Figure 4)

***Claim Rejections - 35 USC § 103***

16. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

17. Claims 6, 7, 9-10 are rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent #6,467,702 to Lambert et al.

In re claims 6, 9-10, Lambert discloses the invention as described above but fails to disclose specific dimensions of the components.

It would have been obvious to one having ordinary skill in the art at time the invention was made to select the proper dimensions of components in order to achieve the desired spray pattern and invention size, since it has been held that where the general conditions of a claim are disclosed in the prior art, discovering the optimum or workable ranges involves only routine skill in the art.

In re claim 7, Lambert discloses the invention as described above but fails to disclose the plurality of micro channels on the conical surface with cross sections that are semi-circles, arcs, triangles, trapezoids, or other polygons.

It would have been obvious to one having ordinary skill in the art at the time the invention was made that the shape of the claimed channels would have been an obvious matter of design choice. Please note that in the instant application applicant has not disclosed any criticality for the claimed limitation.

18. Claim 20 rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. #6,467,702 to Lambert et al. in view of U.S. Patent #4,350,301 to Erwin et al.

Lambert discloses the invention as described above but fails to disclose the needle valve being passively driven by high fuel pressure which provides the driving means.

Erwin however teaches it's known to drive a valve needle using fluid pressure [column 5, lines 33-61] as an equivalent driving means in order to provide enough force to lift the needle and allow fluid to flow through the injector device.

It would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the valve needle and drive system of Lambert to be able to be driven by the pressure of fluid to be sprayed as disclosed by Erwin, because such modification is a known equivalent method of actuating a fuel injector's valve needle.

***Response to Arguments***

19. Applicant's arguments with respect to claims 1-23 have been considered but are moot in view of the new ground(s) of rejection.

***Conclusion***

Any inquiry concerning this communication or earlier communications from the examiner should be directed to JUSTIN JONAITIS whose telephone number is (571)270-5150. The examiner can normally be reached on Monday - Thurs 6:30am - 5:00 pm EST.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Len Tran can be reached on (571)272-1184. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/JUSTIN JONAITIS/
Examiner, Art Unit 3752

/Dinh Q Nguyen/
Primary Examiner, Art Unit 3752